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VERIFICATION OF TRANSLATION

I, the below-named person, hereby certify that I am familiar with both the Japanese language and the English language, that I have reviewed the attached English translation of U.S. Patent Application Serial No. 10/567,031 based on International Filing No. PCT/JP2004/011269 filed on August. 5, 2004, and that the English translation is an accurate translation of the corresponding Japanese language paper.

I further declare that all statements made in this declaration of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful, false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful, false statements may jeopardize the validity of legal decisions of any nature based on them.

Date: May 10, 2006 By: _____

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DESCRIPTION

PACKAGING APPARATUS, MEASURING AND PACKAGING APPARATUS, AND METHOD FOR PRODUCING PACKAGE

Technical Field

[0001]

The present invention relates to a packaging apparatus, a measuring and packaging apparatus, and a method for producing a package of a granular object having adsorption ability, and, more particularly, to a packaging apparatus, a measuring and packaging apparatus, and a method for producing a package of a granular object by which the residual air in the package can be reduced.

Background Art

[0002]

A granular object having adsorption ability such as spherical adsorptive carbon contains a large amount of air, and the amount of air varies tremendously depending on temperature. Therefore, when air is emitted from the granular object with an increase in temperature after packaging, the package is swollen and cause problems during encasement, storage, transportation and so on. Especially, since spherical adsorptive carbon has a granule shape close on a perfect sphere, it has high fluidity. Thus, when air remains in the package, spherical adsorptive carbon granules move in the package. After that, when the air in the package disappears with a decrease in temperature of the package, the package is shrunk. Then, when the package being shrunk is torn to open, the spherical adsorptive carbon granules spill out of the package.

[0003]

Therefore, various measures have been taken, including a measure to charge spherical adsorptive carbon into a package at a high temperature or to seal a package under a pressure lower than atmospheric pressure (see Patent Document 1).

[0004]

Patent Document 1: Japanese Patent Registration No. JP2607422B (pp. 3-4)

Disclosure of the Invention

Problem to be Solved by the Invention

[0005]

However, in some cases, when the air in the package cannot be expelled completely before sealing, the package can be expanded by the residual air with an increase in temperature after sealing. Also, when the air in the package is tried to be expelled completely therefrom, the granular object to be packaged may be scattered. It is, therefore, an object of the present invention to provide an apparatus for packaging a granular object which can reduce the residual air in the package to prevent expansion of the package with an increase in temperature after sealing.

Means for Solving the Problem

[0006]

In order to accomplish the object, a packaging apparatus according to the present invention, comprises as shown in FIG. 1 for example: a charging device 30 for charging a granular object having adsorption ability into a storage bag 90 having an open end; an air removing device 50 for expelling air from

the storage bag 90 into which the granular object has been charged; and a sealing device 40 for sealing the open end of the storage bag 90 from which the air has been expelled; wherein the sealing device 40 is actuated with a slight delay after the air has been expelled from the storage bag 90 by the air removing device 50.

[0007]

In this configuration, since the open end of the storage bag into which the granular object having adsorption ability has been charged is sealed after air has been expelled from the storage bag, the amount of residual air in the packages can be made small. Since the amount of residual air in the packages is small, the packages are not swollen after sealing. To have "adsorption ability" means to have an ability to retain gas such as air therein like spherical adsorptive carbon or activated carbon. The term "storage bags" means bags for containing a granular object. The bags may be separated individually or a plurality of bags may be joined together.

[0008]

The packaging apparatus according to the present invention is, as shown in FIG. 1 for example, the packaging apparatus 100 as described above, wherein the storage bag 90 may be formed by sealing a tube transversely.

[0009]

In this configuration, since the storage bags are formed by sealing the tube transversely, the storage bags can be continuously supplied. Therefore, a packaging apparatus with high operating efficiency can be obtained.

[0010]

The packaging apparatus according to the present invention

is, as shown in FIG. 1 for example, any one of the above packaging apparatuses 100, wherein the air removing device 50 may pinch the storage bag 90, into which the granular object has been charged, to expel air from the storage bag 90.

[0011]

In this configuration, since the air in the storage bag is expelled by pinching the storage bag, the granular object can be prevented from being scattered when the air is expelled from the storage bag .

[0012]

The packaging apparatus according to the present invention is any one of the above packaging apparatuses 100, wherein the granular object having adsorption ability may be spherical adsorptive carbon.

[0013]

In this configuration, since an amount of residual air in the package can be made small, expansion of the package after packaging can be prevented. Therefore, even spherical adsorptive carbon having high adsorption ability can be packaged.

[0014]

The packaging apparatus according to the present invention is, as shown in FIG. 2 for example, any one of the above packaging apparatuses, which may further comprise a heating device 12 for heating the granular object before the storage bag 90 is sealed.

[0015]

In this configuration, since the granular object is heated before being charged into the storage bag and the storage bag is sealed after expelling the air in the storage bag, the sealed package is not expanded even if the temperature is increased

after sealing.

[0016]

In order to accomplish the above object, a packaging apparatus according to the present invention comprises, as shown in FIG. 1 for example: a sealing device 40 for sealing a tube 90 transversely at a first position; a charging device 30 for charging a granular object into the tube 90 sealed at the first position; and a pinching device 50 for pinching the tube into which the granular object has been charged; wherein the tube 90 is sealed transversely at a second position opposite the first position with respect to the pinched part; and wherein the sealing device 40 is actuated with a slight delay after the pinching device 50 has been actuated.

[0017]

In this configuration, the tube into which the granular object has been charged is pinched to expel air therefrom before being sealed, the produced package contains only a small amount of residual air.

[0018]

The packaging apparatus according to the present invention is, as shown in FIG. 1 for example, the packaging apparatus 100 as described above, which may further comprises: a first driving mechanism 52 for driving the pinching device 50; a second driving mechanism 42 different from the first driving mechanism 52 for driving the sealing device 40 ; and a control unit 46 for controlling the driving of the first driving mechanism 52 and the second driving mechanism 42.

[0019]

In this configuration, since the actuations of the pinching device and the sealing device are controlled by the control unit,

both the devices can be actuated at appropriate timing.

[0020]

The packaging apparatus according to the present invention is, as shown in FIG. 1 for example, any one of the above packaging apparatuses 100, wherein the face for pinching the tube 90 is elastic and of a shape corresponding to the shape of tube 90 containing the granular object.

[0021]

In this configuration, the tube is pinched and sealed with the granular object being gathered at a prescribed position.

[0022]

In order to accomplish the above object, a measuring and packaging apparatus according to the present invention, comprises, as show in FIG. 2 for example: any one of the above packaging apparatuses 100; and a measuring device 20 for measuring the granular object to be supplied to the packaging apparatus 100.

[0023]

In this configuration, there is provided a measuring and packaging apparatus in which a granular object can be supplied quantitatively and which can produce a package containing only a small amount of residual air.

[0024]

In order to accomplish the above object, a method for producing a package according to the present invention comprises, as shown in FIG. 2 for example, the steps of: supplying a granular object to the measuring and packaging apparatus described above; measuring the granular object with the measuring device 20; and packaging the measured granular object with the packaging apparatus 100.

[0025]

In this configuration, since a granular object having adsorption ability can be supplied to a measuring and packaging apparatus which can produce a package containing only a small amount of residual air and packaged by the measuring and packaging apparatus, there is provided a packaging method suitable to produce a package containing a granular object.

[0026]

The basic Japanese Patent Application No. 2003-205994 filed on August 5, 2003 is hereby incorporated in its entirety by reference into the present application.

The present invention will become more fully understood from the detailed description given hereinbelow. However, the detailed description and the specific embodiment are illustrated of desired embodiments of the present invention and are described only for the purpose of explanation. Various changes and modifications will be apparent to those ordinary skilled in the art within the spirit and scope of the present invention on the basis of the detailed description.

The applicant has no intention to give to public any disclosed embodiments. Among the disclosed changes and modifications, those which may not literally fall within the scope of the present claims constitute, therefore, a part of the present invention in the sense of doctrine of equivalents.

The use of the terms "a" and "an" and "the" and similar referents in the specification and claims are to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by context. The use of any and all examples, or exemplary language (e.g., "such as") provided herein, is intended merely to better illuminate the

invention and does not pose a limitation on the scope of the invention unless otherwise claimed.

Effects of the Invention

[0027]

As described previously, according to the present invention, the air in the storage bag into which the granular object has been charged is expelled before the storage bag is sealed. Therefore, there is provided a packaging apparatus and a measuring and packaging apparatus for a granular object which can reduce the amount of residual air in the packages to prevent expansion of the packages with an increase in temperature after sealing. Since expansion of the package with an increase in temperature can be prevented, the package can be easily handled during encasement, storage, and distribution, including transport. In addition, the granular object does not spill out of the package when it is opened.

Best Mode for Carrying Out the Invention

[0028]

The embodiments of the present invention are hereinafter described with reference to the drawings. The same or corresponding devices are denoted in all the drawings with the same reference numerals, and the repeated description is omitted.

[0029]

A separately packaging apparatus 100 for spherical adsorptive carbon as a packaging apparatus according to a first embodiment of the present invention is first described with reference to the schematic view of FIG. 1. The separately packaging

apparatus 100 has a charging device 30, a sealing device 40 and a pinching device 50 as an air removing device.

[0030]

The charging device 30 has a chute pipe 31. The chute pipe 31 has the shape of a funnel with a wide opening at the top so that it can receive spherical adsorptive carbon measured in an amount to be packaged separately from a measuring or metering device (not shown). The lower part of the chute pipe 31 is in the form of a thin pipe so that the spherical adsorptive carbon can be fed into a tube 90. The lower end of the chute pipe 31 is opened. The spherical adsorptive carbon falls through the chute pipe 31 by gravity.

[0031]

The sealing device 40 is disposed below the lower end of the chute pipe 31. The sealing device 40 has top seal bars 41 for heat-sealing the tube 90. The top seal bars 41, which are two metal blocks with flat ends, are heated by a heater and pinch the tube 90 from both sides to heat-seal the tube 90. The timing at which the top seal bars 41 pinch the tube 90 is controlled by a sequencer 46 as a control unit. A signal from the sequencer 46 is transmitted to a sealing device driving mechanism 42 through a cable. The sealing device driving mechanism 42 uses the signal to move the two top seal bars 41 toward each other until they press against each other. The top seal bars 41 can move up and down by a distance equal to the length of individual packets.

[0032]

The pinching device 50 is disposed right below the sealing device 40. The pinching device 50 has two air expel guides 51 for pinching the tube 90 containing spherical adsorptive carbon

and a pinching device driving mechanism 52. The two air expel guides 51 are paired with each other. The faces of the air expel guides 51 for pinching the tube 90 are formed by elastic bodies 51a. The elastic bodies 51a are made of rubber or sponge. The elastic bodies 51a may be made of another elastic object such as a synthetic resin. Alternatively, the entire air expel guides 51 may be made of a metal such as a stainless steel without the elastic bodies 51a. In this case, elastic deformation of the pinching faces cannot be expected but the air expel guides 51 have high durability. Each of the tube pinching faces of the air expel guides 51 has a bulged upper portion and a recessed lower portion.

[0033]

The timing at which the air expel guides 51 pinch the tube 90 is controlled by the sequencer 46. A signal from the sequencer 46 is transmitted to the pinching device driving mechanism 52 through a cable. The pinching device driving mechanism 52 uses the signal to move the two air expel guides 52 toward each other until their upper portions press against each other. The air expel guides 51 also can move up and down together with the top seal bars 41.

[0034]

The operation of the separately packaging apparatus is next described with reference to FIG. 1. The tube 90 is produced by forming a flat tape into a tubular shape around the lower end of the chute pipe 31 and heat sealing the overlapped portions thereof. The tube 90 is sealed transversely at a prescribed position by the sealing device 40 as described later. The tube 90 is formed into a bag shape having a sealed bottom and an open end and placed with its opening facing the lower opening of the

chute pipe 31. The storage bags for the spherical adsorptive carbon are preferably produced from the tube 90 since the storage bags can be supplied continuously. The storage bags are not necessarily joined as a tube but may be separated individually, though. For example, the storage bags may be in the shape of a circular cylinder, quadratic prism, tetrahedron, or hemisphere.

[0035]

The spherical adsorptive carbon measured by a measuring device (not shown) is poured into the bag-shaped part of the tube 90 through the chute pipe 31 and is heaped up in the lower part of the bag-shaped part. Since each spherical adsorptive carbon granule is almost perfectly spherical and has high fluidity, those granules must be gathered in the lower portion of the bag and the upper portion of the bag must be empty. Otherwise, the spherical adsorptive carbon granules spill out when the bag is opened. Therefore, the spherical adsorptive carbon has to be heaped up in the lower portion of the bag-shaped part and the upper portion of the bag-shaped part must be empty.

[0036]

When spherical adsorptive carbon is charged in the tube 90, the pinching device driving mechanism 52 is actuated by a signal from the sequencer 46, and the air expel guides 51 pinch the bag-shaped part of the tube 90 from both sides. When the bag-shaped part of the tube 90 is pinched by the air expel guides 51, the air in the bag-shaped part is expelled. Since the pinching device driving mechanism 52 has a servomotor, the speed of the air expel guides 51 is so controlled that the air expel guides 51 can pinch the tube 90 at such a speed that the air can be expelled quickly without causing the spherical

adsorptive carbon to leap in the tube 90. Also, the servomotor controls the air expel guides 51 to pinch the tube 90 at an appropriate pressure to expel the air in the tube 90.

[0037]

Since the faces of the air expel guides 51 for pinching the tube 90 have a bulged upper portion and a recessed lower portion, the spherical adsorptive carbon is placed in the gap between the lower portions of the paired air expel guides 51. When the air expel guides 51 for pinching the tube 90 have a flat face with a recessed lower portion, they can be produced easily. The air expel guides 51 may have a curved face corresponding to the shape of the sealed packets, through. Since the upper portions of the air expel guides 51 are moved toward each other until they contact, no spherical adsorptive carbon can stay in the upper portion of the tube 90.

[0038]

Since the faces of the air expel guides 51 for pinching the tube 90 are formed by the elastic bodies 51a made of rubber or sponge, they can be deformed even if the shape of the part of the tube 90 containing the spherical adsorptive carbon is slightly changed when they pinch the tube 90. Therefore, the air can be expelled reliably without damaging the tube.

[0039]

In addition, it is advantageous that, since the faces of the air expel guides 51 for pinching the tube 90 are formed by elastic bodies 51a, the apparatus can be used by replacing only the elastic bodies 51a even if the amount of spherical adsorptive carbon to be packaged in individual packets is changed or the type of granular object to be packaged is changed.

[0040]

Almost as soon as the air expel guides 51 complete to pinching the tube 90, a signal from the sequencer 46 actuates the sealing device driving mechanism 42 and the top seal bars 41 pinch transversely the part of the tube 90 immediately above the part from which air has been expelled by the air expel guides 51. The top seal bars 41 are driven by the sealing device driving mechanism 42 separately from the air expel guides 51. Since the sealing device driving mechanism 42 has a servomotor, the top seal bars 41 pinch the tube 90 at an appropriate pressure to seal the tube 90. Since the air expel guides 51 and the top seal bars 41 are driven by different driving mechanisms, both the air expel guides 51 and the top seal bars 41 can pinch the tube 90 at appropriate timing, speed, and pressure. Since the top seal bars 41 are heated by a heater (not shown), the tube 90 is sealed transversely and closed when pinched by the top seal bars 41. The tube 90 is made of a multi-layer film having an inner layer of a heat-sealable plastic film and can be sealed when pinched by heated top seal bars 41. The top seal bars 41 may seal the tube 90 by means other than heat sealing, such as ultrasonic sealing.

[0041]

Since the top seal bars 41 pinch the tube 90 to seal it slightly after the pinching device 50 has been actuated and the air expel guides 51 have pinched the tube 90 to expel the air in the tube 90, the air in the tube 90 can be expelled reliably.

[0042]

The slight time difference can be adjusted to a proper value by the sequencer 46. For example, when 40 packets are produced per minute, that is, the pinching and sealing is conducted 40 times per minute, the time difference is 0.05 to 0.15 seconds,

preferably 0.07 to 0.12 seconds.

[0043]

The sequencer 46 may control not only the operation of the top seal bars 41 and the air expel guides 51 but also the entire operation of the apparatus as described later.

[0044]

The top seal bars 41 move down a distance equal to the length of a packet while pinching the tube 90. By this movement, the sealed part made to close the packet containing spherical adsorptive carbon becomes the bottom of the next bag-shaped part of the tube 90. The top seal bars 41 and the air expel guides 51 are supported by the same beam (not shown). The air expel guides 51 move in synchronization with the movement of the top seal bars 41.

[0045]

As described above, the packets produced by the separately packaging apparatus 100 for spherical adsorptive carbon according to the first embodiment of the present invention are suitable for packaging spherical adsorptive carbon since they contain a small amount of residual air. It is preferred to heat the spherical adsorptive carbon before sealing with the sealing device 40 since expansion of air in the packets with an increase in temperature after packaging can be prevented more reliably. For that purpose, there may be provided, for example, a heating device for heating the spherical adsorptive carbon in the chute pipe 31 or a heating device for heating the spherical adsorptive carbon charged in the tube 90. Alternatively, the hopper for receiving the spherical adsorptive carbon to be packaged may be provided with a heating device as described later. In this case, the hopper constitutes a part of the separately packaging

apparatus. The heating with a heating device must be conducted before sealing, preferably before expelling air. More preferably, the spherical adsorptive carbon is heated in the hopper in which it stays for a long time.

[0046]

Here, the term "packet" means each of the sealed bags containing a granular object measured by the measuring device, and the term "package" means each packet or set of packets cut at the sealed parts and discharged from the packaging apparatus.

[0047]

Although the sealing device 40 pulls down the tube 90 while pinching it and the tube 90 is intermittently transported in the above embodiment, the tube 90 may be continuously transported by another device and the sealing device 40 and the pinching device 50 may be moved up and down in synchronization with the movement of the tube 90. Alternatively, the tube 90 may be transported sequentially by another device but the sealing device 40 and the pinching device 50 do not move up and down, and the transport of the tube 90 may be stopped while it is pinched and sealed.

[0048]

A measuring and packaging apparatus according to a second embodiment of the present invention is described with reference to the schematic view of FIG. 2. FIG. 2 shows a measuring and packaging apparatus for spherical adsorptive carbon provided with a separately packaging apparatus 100 according to the first embodiment of the present invention.

[0049]

A hopper 10 and a measuring device 20 are disposed above a separately packaging apparatus 100. The hopper 10 is a

container having a wide upper opening and narrowing gradually toward the lower end. The lower end of the hopper 10 is opened and communicated with a filling nozzle 16. The hopper 10 has a heater 12, and the spherical adsorptive carbon in the hopper is heated at 60 to 80°C. Alternatively, hot air from a heater may be passed through the hopper to heat the spherical adsorptive carbon at 60 to 80°C.

[0050]

The filling nozzle 16 under the hopper 10 is a thin pipe so that the spherical adsorptive carbon in the hopper can be discharged little by little. The filling nozzle 16 may have a flow control valve (not shown) the opening and closing of which is controlled by the sequencer 46. The lower end of the filling nozzle 16 is located and opened in a through hole 22a of a holder 22.

[0051]

The holder 22 is combined with a measuring vessel 21 reciprocating horizontally under the holder 22, a shutter 24 placed under the measuring vessel 21, and springs 23 for pressing the holder 22 against the measuring vessel 21 under the holder 22 to constitute the measuring device 20. The springs 23 are provided to keep the holder 22 in close contact with the measuring vessel 21 so that the spherical adsorptive carbon granules cannot be caught between them and cannot scratch the surfaces thereof. The springs 23 may not be provided.

[0052]

The measuring vessel 21 has a space 21a with a capacity equal to the volume of spherical adsorptive carbon to be measured. The space 21a is communicable with the through hole 22a of the holder 22. When the measuring vessel 21 moves horizontally,

the space 21a is communicated with a through hole 24a of a shutter 24. The through hole 24a of the shutter 24 has a lower opening connected to a chute pipe 31.

[0053]

The sealing device 40 and the pinching device 50 described before are disposed below the opening of the chute pipe 31.

[0054]

A cutting device 60 is disposed below the pinching device 50 for cutting the packets 91 containing spherical adsorptive carbon by each or by a plurality of packets 91 to produce a package 92. The cutting device 60 has two blades which pinch and cut the tube 90. The package 92 of a plurality of packets 91 joined end to end may be perforated at the sealed parts left uncut so that packets 91 can be easily separated by hand. Therefore, the cutting device 60 may also have blades each of which has an edge with notches at equal intervals and which are operated at different timing from the cutting blades. The operation of the cutting device 60 is also controlled by the sequencer 46.

[0055]

A receiving table 61 is located below the cutting device 60. The receiving table 61 is a tilted plate that allows the cut package 92 to fall obliquely to reduce the impact of the fall. The receiving table 61 has a shock absorbing roller 62 for further reducing the falling speed of the packages 92. The shock absorbing roller 62 is located in such a position that the package 92 passes between two cylindrical rollers of the shock absorbing roller 62 while sliding down on the receiving table 61. Since the package 92 rotate the rollers when passing therebetween, the falling speed of the package 92 is reduced.

The shock absorbing roller 62 may have only one roller. Another means for reducing the falling speed of the package 92 may be provided instead of the shock absorbing roller 62. For example, some means for increasing friction may be provided on the receiving table 61.

[0056]

A cooling device 70 is disposed downstream of the receiving table 61. The cooling device 70 has a conveyor 71 and supports 72 for supporting the package 92 in an obliquely upstanding position arranged on the conveyor 71 and moving together with the conveyor 71. The supports 72 are plates or rods obliquely extending from the conveyor 71. The supports 72 support the package 92 such that the short sides of the package 92 are perpendicular to the transporting direction. Then, a larger number of package 92 can be supported on the conveyor 71 with the same length. At the end opposite the receiving table 61 where the conveyer 71 turns around, the package 92 fall by gravity. The package 92 falls into a container for packing the package 92, and the package 92 is packed and shipped.

[0057]

The method of producing the package 92 of spherical adsorptive carbon is next described with reference to FIG. 2. Spherical adsorptive carbon is supplied into the hopper 10 through the upper opening thereof and temporally stored in the hopper 10. The spherical adsorptive carbon is heated at 60 to 80°C by the heater 12 while being stored in the hopper 10. This is to package spherical adsorptive carbon at the possible highest temperature so that the packets cannot be expanded by air emitted from the spherical adsorptive carbon with an increase in temperature after packaging.

[0058]

The spherical adsorptive carbon gradually descends in the hopper 10 and flows into the filling nozzle 16 from the lower end of the hopper 10. A flow control valve to adjust the flow of discharged spherical adsorptive carbon is provided in the filling nozzle 16 so that the appropriate amount of spherical adsorptive carbon is discharged.

[0059]

The spherical adsorptive carbon is supplied from the filling nozzle 16 into the space 21a of the measuring vessel 21 through the holder 22. When the space 21a is filled with spherical adsorptive carbon, the measuring vessel 21 moves horizontally. Then, the spherical adsorptive carbon in the space 21a is fed into the chute pipe 31 through the through hole 24a of the shutter 24. Spherical adsorptive carbon in an amount equal to the capacity of the space 21a is measured by a measuring device 20.

[0060]

Each clump of spherical adsorptive carbon measured as described above is supplied into the tube 90 through the chute pipe 31. Air is expelled out of the tube 90 containing spherical adsorptive carbon by the pinching device 50 as described before, and the tube 90 is sealed to form packets 91 by the sealing device 40.

[0061]

The packets 91 are cut at the sealed parts into individual packets or packages of, for example, three packets by the cutting device 60. When the packets 91 are cut into packages of a plurality of packets, the packages may be perforated at the sealed parts between the packets 91 by being pinched between blades each having an edge with notches at equal intervals so

that the individual packets can be easily separated by hand.

[0062]

The package 92 cut by the cutting device 60 slides down on the receiving table 61, is reduced in falling speed by the shock absorbing roller 62 and falls down onto the cooling device 70. Since the package 92 falls onto the cooling device 70 at a low speed, the seals at the bottoms of the package 92 are not damaged by the impact of the fall. The package 92 fed onto the cooling device 70 is held in an obliquely upstanding position by the supports 72 and transported on the conveyor 71 of the cooling device for one to five minutes. The package 92 may be transported on the conveyor 71 at room temperature or exposed to cool air while being transported. During this time, the spherical adsorptive carbon heated to 55 to 80°C in the hopper 10 and still keeping the temperature is cooled to almost room temperature. When cooled, the package shrinks and the spherical adsorptive carbon cannot move any more in the lower portion of packets 91.

[0063]

When the package 92 is transported to an end of the conveyer 71, the conveyor 71 turns downward and the package 92 falls by gravity. A packing box is placed at the position where the package 92 falls. When a predetermined number of packages 92 are put in the box, the box is carried away.

[0064]

Here, spherical adsorptive carbon to be packaged by the separately packaging apparatus according to the first embodiment of the present invention or packaged by the measuring and packaging apparatus according to the second embodiment of the present invention is described. The spherical adsorptive

carbon granule is of porous spherical carbon object with granule size between 0.05 and 1 mm in diameter and a bulk density of 0.51 ± 0.04g/ml. Since the spherical adsorptive carbon granule is of a perfect spherical shape and has high fluidity, it is likely to be scattered in opening a packet. Also, spherical adsorptive carbon contains a large amount of air, and the amount of air tremendously varies depending on temperature. For example, when spherical adsorptive carbon is heated from zero to 30°C, it emits 1.46 ml of air per gram. Since spherical adsorptive carbon is heated at 60 to 80°C to fully expel air therefrom and cooled after being sealed in the packets, a vacuum is established in the packets. Therefore, the packets do not expand even if the temperature increases in ordinary circumstances.

[0065]

Although spherical adsorptive carbon is taken as an example of the granular object to be measured and packaged, the present invention is suitably applicable to any granular objects having adsorption ability and a perfect spherical shape. The packaging apparatus, the measuring and packaging apparatus, and the method for producing a package according to the present invention are applicable to other granular objects, especially to granular objects having adsorption ability. Any device for expelling the air in the storage bags can be used instead of the pinching device as the air expelling device. For example, a decompressor may be used. When a decompressor is used, the open end of the storage bag is preferably covered with a screen so that the granular object cannot scatter when the pressure in the storage bag is reduced. The mesh size of the screen must be smaller than the granule size of the granular object so that

the granular object cannot pass through the screen even when the screen is deformed. The pressure does not have to be reduced to a high vacuum as long as the pressure can be reduced to such a degree that the air in the storage bag can be expelled. Although the present invention is described as a separately packaging apparatus for packaging spherical adsorptive carbon into packets, the present invention is applicable to ordinary packaging.

Brief Description of Drawings

[0066]

FIG. 1 is a schematic view, illustrating a packaging apparatus according to a first embodiment of the present invention.

FIG. 2 is a schematic view, illustrating a measuring and packaging apparatus according to a second embodiment of the present invention.

Description of Reference Numerals

[0067]

10: hopper

12: heating device

20: measuring device

30: charging device

31: chute pipe

40: sealing device

41: top seal bar

42: sealing device driving mechanism (first driving mechanism)

46: sequencer (control unit)

50: pinching device (air removing device)

51: air expel guide

52: pinching device driving mechanism (second driving mechanism)

60: cutting device

61: receiving table

62: shock absorbing roller

100: separately packaging apparatus (packaging apparatus)